GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Bachelor of Science

Level: Under Graduate

Branch Name: Honors/ Honors With Research (Biotechnology)

Course / Subject Code: BS03001021

Course / Subject Name: Genetic Engineering

W.e.f. Academic Year:	2025-26
Semester:	3
Category of the Course:	Core Courses

Prerequisite: Students should understand the fundamentals of nucleic acids, including their structure and biochemistry. They should have basic knowledge of molecular biology and genetics.
Rationale: The objectives of this course are to teach various approaches to conducting genetic engineering and its applications in biological research as well as in biotechnology industries. In conjunction with practicals in molecular biology and genetic engineering, students should be able to engage in biological research and secure placements in relevant biotech industries.

Course Scheme:

Teaching Scheme			Total Credits	Assessment Pattern and Marks				Total Marks
				Theory		Practical		
L	T	PR	C	ESE (E)	PA(M)	ESE (V)	PA (I)	
3	0	2	4	70	70	30	30	200

Course Content:

Sr. No.	Course Content	No. of Hours	% of Weightage
1	**Basic Concepts and Tools of Gene cloning** Introduction to gene cloning, vehicles of gene cloning, isolation and purification of DNA from bacteria, plant and animal cells, Manipulation of purified DNA, Introduction of DNA into living cells, Different methods of horizontal gene transfer; Restriction enzymes, ligases, polymerases, alkaline phosphatase, vector and non-vector mediated gene transfer methods	10	22
2	**Cloning Vectors and Host Strains** Vehicles: Plasmids, Bacteriophages and viruses, Phagemids and Cosmids; Bacterial Artificial Chromosomes; Vectors for yeast and other fungi: 2µ plasmid, YACs; To obtain a clone of a specific gene: Salient features of Host strains.	10	21
3	**Methods of Gene Manipulation and Selection of Clones** Screening and selection of clones, Random and site-directed mutagenesis: Primer extension and PCR-based methods of site-directed mutagenesis, Random mutagenesis, Gene shuffling, obtain a clone of a	10	21

	specific gene: Direct selection, Selection using hybridization from Genomic DNA library, cDNA library; Probe designing and labelling; Identification of clones using alternative methods		
4	**Studying gene location and structure** Gene location: Hybridization techniques (Southern, Northern Western) FISH, Studying gene structure; DNA sequencing: Sanger's method of chain termination and Maxam Gilbert's method of chemical degradation; Polymerase Chain Reaction and its types.	10	22
5	**Applications of Genetic Engineering** Genetic engineering in plants: Use of *Agrobacterium tumefaciens*. Ti plasmids, Strategies for gene transfer to plant cells, Direct DNA transfer to plants, Gene targeting in plants, Therapeutic products produced by genetic engineering-blood proteins, human hormones and vaccines.	5	14

Reference Books:

1. Brown TA. (2006). Gene Cloning and DNA Analysis. 5th edition. Blackwell Publishing, Oxford, U.K.
2. Clark DP and Pazdernik NJ. (2009). Biotechnology-Applying the Genetic Revolution. Elsevier Academic Press, USA. Delhi.
3. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington
4. Primrose SB and Twyman RM. (2006). Principles of Gene Manipulation and Genomics, 7th edition. Blackwell Publishing, Oxford, U.K.
5. Sambrook J, Fritsch EF and Maniatis T. (2001). Molecular Cloning-A Laboratory Manual. 3rdedition. Cold Spring Harbor Laboratory Press

Course Outcome:

After Completion of the Course, the Student will be able to:

Sr. No	Course Outcomes	RBT Level
1	Understanding Gene Cloning Techniques	UN.RM
2	Applying Cloning Vectors and Host Strains	UN.RM,AP
3	Analyzing Methods of Gene Manipulation	UN.RM,AN
4	Evaluating Applications of Genetic Engineering	UN.RM,EL

*RM: Remember, UN: Understand, AP: Apply, AN: Analyze, EL: Evaluate, CR: Create

List of Experiments:

1. Genomic DNA isolation from bacteria
2. Plasmid DNA isolation

3. Assessment of quality and quantity of DNA
4. Agarose gel electrophoresis to visualize DNA
5. Restriction digestion
6. DNA ligation
7. DNA transformation
8. PCR (Demonstration)

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